TEXTILE RESEARCH

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In This Month's Issue

Textile Research Institute to Establish at Princeton

Definite decision has been reached by the Institute to establish headquarters at Princeton, N. J., for the prosecution of research and for the training of personnel on the graduate level. (See page 66.)

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Post-War Textile Research

The textile industry's main consideration must be that of consumer performance. It must think of its manufacture in terms of end-use products. This is not merely a pleasant idea; it is a grim necessity. (See page 67.)

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Textile Applications for Glycerine

The importance of glycerine in textile applications for peacetime as well as war-time use in receiving increased recognition. A survey of recent literature reveals many of these applications. (See page 69.)

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Vibrations in Textile Testing Devices

Certain modifications in their sliver and roving testers at the Chicopee Mfg. Corp. have greatly increased the speed of testing. (See page 76.)

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The Scale Substance of Wool

Research conducted by the Textile Foundation, working at the National Bureau of Standards, has revealed additional information in regard to the nature of the scale substance of the wool fiber. (See page 82.)

Textile Research Institute to Establish Headquarters at

Princeton, New Jersey

DEFINITE decision by the Textile Research Institute, Inc., to establish headquarters at Princeton, N. J., for the prosecution of research and for the training of personnel on the graduate level, has been announced by the Institute. At the same time, the proposal was hailed by President H. W. Dodds of Princeton University as "in the best tradition of Princeton as a center for education, scholarship and research."

The decision was reached after a very careful study and examination of the facilities at many universities, by a special committee appointed by the Institute for this purpose. The actual move will take place as soon as it is feasible to secure and equip laboratories.

President Dodd's Comment

In commenting on the plan, President Dodd's stated:

"The Proposal by Textile Research Institute, Inc., to establish headquarters in Princeton, New Jersey, (a) for the prosecution of a program of research in fundamental and applied science, basic to the textile industry and in economic research, (b) for the dissemination of research information and (c) for the training of personnel in such methods of study and research, is in the best tradition of Princeton as a center for education, scholarship and research. The Rockefeller Institute, the Institute for Advanced Study and the R.C.A. Laboratories, among others, have already added to and availed themselves of the educational opportunities that the University, in an earlier period, alone provided.

"In accordance with a practice already established in its relations with such institutions in the community, the University would expect to make available to properly qualified personnel of the Textile Research Institute the opportunity to enroll in graduate courses and proceed to advanced degrees in Princeton University so far as this could be achieved within the restrictive quota regulations that govern the operation of the Graduate School. The program of study and the research work of those so involved would be arranged to the mutual satisfaction of both Graduate School and Textile Research Institute."

Deciding Factor in Post-War Textile Research Will Be

The Public Interest

By DOUGLAS G. WOOLF

The silent partner in post-war industrial research will be the consumer. The silence of the consumer as a partner in industry is due to the lack of articulation. But theirs is a silence that speaks louder than words. It can make or break an industry, or an individual company.

Much of the approach to this problem of the consumer's interest in industrial affairs has been sheer bunk. The inclusion of so-called consumer members in NRA committees, and of so-called public members in wage-hour committees, have been examples of that bunk. The loud-mouthed platform performance of many groups presuming to speak for the consumer is another example. Consumers are not pressure-groups; they are all of us. Their pressure is exerted as individuals at the retail counter. Mass buying-strikes and boycotts are rare, and largely ineffectual; they serve merely as sporadic demonstrations of the latent power of public interest.

The primary stake which consumers have in industrial affairs is their desire to obtain the best products at the lowest price. Their secondary stake is in wage-and-hour structure and working conditions of an industry, since the majority of consumers are employees. A tertiary consideration—but a very poor third—is the profit status of industries themselves. Academically, consumers want to see companies make money, out of their sense of fair play; but the direct interest which they have in industrial securities is relatively minor. Consequently, an industry must direct its public-relations program toward (1) constantly improving the quality, performance, and versatility of its products and constantly lowering the unit price consistent with that achievement; and (2) establishing a reputation as a good place in which to work.

What This Means in Research

Applying that yardstick to applied research, the textile industry's main consideration must be that of consumer performance. It must think of its manufacture in terms of end-use products. This is not merely a pleasant idea; it is a grim necessity. The invasion of textile markets by other industries had progressed alarmingly before the war; it will be intensified in the post-war period. The outstanding example is competition from paper. This, in turn, was due very largely to research. The all-out research program conducted under the auspices of

the Institute of Paper Chemistry, starting in 1929, was the fundamental reason for the successful substitution of paper for textiles. However it was accompanied by shrewd merchandising and promotion. The average housewife, even though she may have had a predilection for textiles, was seduced, commercially, by the salesman of paper products with a complete line of necessities and luxuries, conveniently packaged and arranged in enticing combinations, at low prices.

War-time research doubled the threat from this source. News of so-called "wet-strength paper" developed for military uses and for essential commercial uses such as bags, etc., promises to give the strongest industrial fabrics a run for their money after the war. True, textiles have been improved due to research on military fabrics, but from all accounts the extent of improvement has been much less than that in paper.

To overcome this handicap, the textile industry must concentrate on a broad-gauged program of holding its markets, irrespective of specific types of fibers or types of machinery. In a war for survival, one cannot always pick his own weapons. Industrial battlefields of the past have been strewn with the wrecks of companies and industries who tried to protect their dividends against new enterprise, by holding fiercely to methods of the past. Mortality among industries and companies with this attitude will be greater in the post-war period than ever before.

"A Good Place in Which to Work"

On the second point of interest which the public has in industrial affairs, mentioned above, the value of public approval of an industry's employer-employee relations was largely ignored in the past, but of recent years has gained recognition. However, this asset cannot be achieved by public-relations programs unless these are based on fact. And the real basis is a sound economic structure making possible a sound wage structure, continuity of employment, and good working conditions. That in turn calls for broad-gauged economic research, synchronized with technical research, so that the results of technological advance will be reflected in economic progress.

Beyond this basic essential research, there must be a continuing merchandising program which will make the consumer conscious of the advantages he or she can derive from the use of the industry's products. Promotion should not dictate the methods of research, but promotion should utilize the results of research. That's just plain good business.

Many important research institutes and foundations, recently established, have emphasized these public-interest phases. The Textile Research Institute, Inc., is glad to share in this attitude. To repeat, it does so for no abstract purpose. It gives lip service to no precious thought. It is following the only sure route towards survival of the textile industry in the post-war period.

Survey of Recent Literature Reveals Numerous

Textile Applications for Glycerine

By GEORGIA LEFFINGWELL, PH.D.

Statement by the War Production Board that "glycerine is vitally necessary in military dyes" [1][1] emphasizes the importance of this product to the textile industry; an importance receiving increased recognition for peacetime as well as war-time use.

Forced to resort to substitutes during the period when the available glycerine was diverted principally to the more immediate military needs, everyone familiar with the unique combination of properties inherent in glycerine soon realized that, although individual qualities of the fluid might be duplicated, there is no substitute for its all-around usefulness.

Glycerine in Dyeing

The several outstanding qualities present in glycerine have been thoroughly discussed in previous articles [2]. Because of its action as a solvent, suspending medium, hygroscopic agent, thickener, dispersant and penetrant, glycerine finds wide use in dyeing processes. An example is its use in conjunction with vat dyes, rapidogens, rapid fast, indigosol, and other types of dyestuffs. Of interest in this connection is the utilization of glycerine in Russian methods for dyeing spun linen [3]. Using a modified apparatus of the Esser type, various dye mixtures are employed; glycerine being utilized to work up the dye into a paste. In one case, to dye blue shades, dyeing being done for one hour at 60° C., the following mixture was used:

Chlorindanthrene Blue	1.7 kg.
Sodium hydroxide (40° Be.)	39.0 liters
Hyposulfite	6.4 kg.
Glycerine	0.5 kg.

Steaming or aging is an important phase of many dyeing procedures to assure good chemical reaction of the coloring material and its fixation on the fibers. These processes generally are assisted by the presence of a hygroscopic agent such as glycerine [4]. An interesting departure from the usual practice is offered in a recently patented method [5], now vested in the Alien Property Custodian, for steaming textile materials such as cotton yarn. In this method, a process is employed which involves preheating a treating liquid consisting of formalin, Turkey-red oil and glycerine, introducing this preheated liquid into a steam current, and feeding the stream carrying the treating fluid to the textile material.

Glycerine in Textile Printing

In processes for the printing of direct colors, glycerine affords definite aid in securing optimal effects. A

[1] Figures in brackets indicate literature references at end of this paper.

typical application is given in the following formula [6]:

Direct color	20 Gm.
Hot water	310 Gm.
Glycerine	50 Gm.
Sodium phosphate	20 Gm.
Starch-tragacanth thickener	500 Gm.
Egg albumin	100 Gm.

Print, dry, steam for one hour without pressure, then rinse in water containing salt. Increased water-fastness can be attained by aftertreating with ¼ oz. of Fastogene per gallon of water at 100° F.

Although practically all of the substantive colors may be printed, only a selected few have sufficient resistance to steaming, wash-fastness and solubility to make them suitable for satisfactory direct printing with a combination such as the above mixture. Among suitable colors for this purpose, the following may be listed: Chrysophenine G, Benzo Orange R, Pluto Brown GG, Benzo Fast Scarlet 8BA, Amanil Fast Violet RRL, Benzo Azurine 3R, Benzo Green FFG, Direct Deep Black E.

As the best known and most generally used hygroscopic agent in the screen printing of rayons, glycerine has an important application in the printing of vat colors. Here it serves to assist in the absorption of moisture during the steaming process and so definitely aids in the fixation of the dyestuff on the fiber [4].

Glycerine is of service also in instances where thickening agents dry and clog the meshes of the printing screens. This is especially apt to occur in the type of printing table which is heated from below by means of steam pipes. In such cases the screens heat up readily, especially if they are made of bronze and the printing pastes are fairly viscous. This may be obviated to some extent, according to one authority [4], by the use of glycerine.

The formulation of print resists also takes advantage of the several desirable characteristics imparted by glycerine. A case in point is offered in the following textile print resist [6]:

Zinc Oxide	200 parts
Water	170 "
Glycerine	25 "

Beat into a paste, and then add:

Dark British gum	200 parts
Gum Senegal (50% solution)	150 "
Turpentine	30 "

Other Textile Applications

Aside from its important uses in dyeing, printing, and related techniques, glycerine finds extensive application in other phases of textile treatment. One such is its frequent inclusion in textile oils and lubricants, where its presence not only facilitates processing but also contributes to the soft feel of the finished fabric. Illustrative is a combination, described in a foreign technical journal [7], for the oiling of French worsted fabrics. This is an emulsion consisting of 20 percent coriander oil with a mixture of 4 percent technical glycerine and 1.8 percent ammonia in 2 percent aqueous solution.

Alkyd Resins

Because it is an aliphatic, trihydroxy alcohol, glycerine readily enters into chemical reaction with other substances to produce many valuable derivatives and new compounds. Of

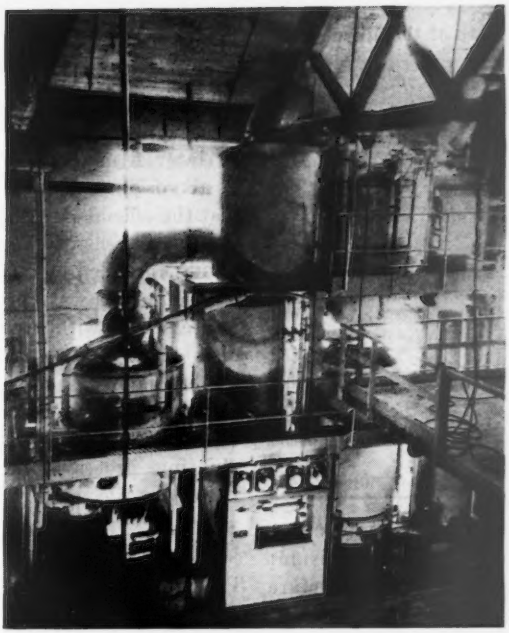


Fig. 1. A typical installation of glycerine refining equipment.

these, none equals in importance and versatility the group of synthetic resins known as the alkyds. Generally prepared by the interaction between glycerine and phthalic acid or similar polybasic acid, chemists have learned how to modify these resins with oils and other materials to meet an almost infinite variety of industrial needs. These resins, employed alone or in conjunction with other synthetic resins, are of value in the production of protective coatings for all types of materials. So efficient have they proved to be that, by Federal specifications, most alkyd resins were diverted for use in making paints for planes, ships, tanks, guns, and other military and naval installations where toughness, durability, and resistance were prime considerations [8].

Of course, it was not long before the textile industry recognized the potentialities of alkyd resins for use in coating and treating fabrics, and today these applications constitute a major field of utility for these resins [9, 10]. Recently, in a discussion on plastic coatings for fabrics in the post-war era, Cleaveland [11] tabulated the properties of the several plastics and resins which make them so useful in this connection. (See accompanying table.)

These characteristics help to explain the already established utility of the alkyds in fabric coatings for making transparent finishes, electrical insu-

TABLE I. Properties of the alkyd group

Abrasion resistance	Fair
Acid resistance	Fair
Alcohol resistance	Fair
Alkali resistance	Fair
Cold resistance	Fair
Flammability resistance	Good
Gasoline resistance	Good
Heat resistance	Good
Sunlight resistance	Good
Tack resistance	Fair
Water resistance	Fair
Adhesion	Good
Color	Good
Compatibility	Good
Flexibility	Good
Heat-sealing ability	Poor
Odor	None
Solubility	Good
Price rating	Low

lating cambric, and, very pertinent today, for the production of gas-resistant fabrics useful in chemical warfare [11]. Wash-resistant glaze finishes can be produced by coating the fabric with an emulsion of alkyd resins [9]. The more recent patent literature reveals growing application of these resins in textile finishes [12, 13], in processes for glazing chintz fabrics [14], and as plasticizers for resinous adhesives used in bonding fabrics to make a plurality of fabric plies [15]. Of interest in connection with the use of alkyds in the war effort is the fact that the official British Pharmaceutical Codex has recently accepted as a substitute for oiled silk (used in bandaging wounds) a waterproof rayon fabric impregnated with an alkyd (glyptal) resin [16].

More important to the textile colorist, however, is the increasing tendency to employ alkyd resins in dyeing and printing processes. In some of the newer textile printing pastes, alkyd resins serve as the chief component of the emulsions [17], while in other printing processes, these alkyds, suitably modified to meet specific requirements, are used to plasticize other film forming synthetic resins, e.g., urea-formaldehyde resins [18].

Kienle and Peiker [19] have recently patented a process for coloring textile fabrics in which the coloring substance is incorporated in a dispersion of long-oil alkyd resin having water as the continuous phase. Thus, in an example cited in the patent, a mixture of 2 parts of Ultra-marine Blue, 1 part of Indanthrene Blue B.C.S. (C.I. 1114) and 0.53 part of copper phthalocyanine is used with 100 parts of an emulsion composed of 66.6 parts of alkaline casein solution, 16.6 parts of an oxidizing type alkyd resin (oil length 60 and acid number 37–34), 8.4 parts of

Fig. 2. Weaving a rayon fabric. Glycerine has important uses in connection with various preparatory, dyeing, and finishing treatments.

a butanol solution of dimethylolurea (60% resin) and 8.4 parts of dimethylolurea resin. This was ground, printed on cellulose fabrics and cured for five minutes at 150° C. With this method, prints fast to washing soaps, alkali and chlorine, and cellulose acetate solvents were obtained.

Of related pertinence is the use of alkyd resins, in conjunction with other synthetics for protective coatings for covering or impregnating supports for dyeing or the like. Thus, according to one patent [20], supports for dyeing or other fluid treatments of yarn in package form are made by impregnating and coating a perforated tube with the reaction products of a partially condensed phenolaldehyde resin and a partially condensed alkyd resin. In another procedure developed by the same inventor [21], dye-resistant coating compositions, suitable for use on yarn supports or the like, are made from the interaction between a modified glycerine-phthalate resin and an ester gum-modified phenol resin.

This brief review, which covered the developments reported in less than a year of the industrial and patent literature, offers substantial evidence that glycerine is a major essential in textile processes and that there is no general substitute for its versatile properties.

References

[1] Division of Information: "Glycerine Report," WPB-3363 (Apr. 1943).

[2] Leffingwell, G. and Lesser, M. A., *Textile Colorist* **62**, 743 (1943); *ibid.* **65**, 5 (1943).

[3] Bochenkov, A. V., *Prom. Lubyanykh Volokon* **10**, No. 9–10, 13 (1940) (through *Chem. Abstr.* **37**, 5246, 1943).

[4] "Technicus," *Rayon Textile Mo.* **24**, 65 (Aug. 1943); *ibid.* **24**, 59 (Oct. 1943); *ibid.* **24**, 65 (May 1943).

[5] Langen, H., U. S. Pat. 2,297,230 (Sept. 29, 1942).

[6] Bennett, H., "Chemical Formulary," Vol. VI, New York, Chem. Publishing Co., pp. 518–9 (1943).

[7] Violin, V. F. and Shampanskii, A. S., *Sherstyanoe Delo* **19**, No. 8, 6 (1940) (through *Chem. Abstr.* **37**, 2940, 1943).

[8] Glaser, M. A., *Indust. Finishing*, p. 51 (Oct. 1943).

[9] Gurley, M. H., Jr., *Rayon Text. Mo.* **23**, 726 (1942).

[10] Leffingwell, G. and Lesser, M. A., *Rayon Text. Mo.* **24**, 63 (Oct. 1943).

[11] Cleaveland, J. B., *Textile World*, **93**, 59 (May, 1943).

[12] Light, D. W. and Mite, A. D., Canadian Pat. 409,907 (Jan. 12, 1943).

[13] Thackston, W. J., U. S. Pat. 2,295,699 (Sept. 15, 1942).

[14] Corteen, H., U. S. Pat. 2,307,876 (Jan. 12, 1943).

[15] McBurney, J. D. and Nollan, E. H., U. S. Pat. 2,312,925 (March 2, 1943).

[16] Anon., *Pharmaceutical J.* **150**, 46 (1943).

[17] Cassel, N. S., U. S. Pat. 2,310,012 (Feb. 2, 1943).

[18] Johnson, M. W., U. S. Pat. 2,310,436 (Feb. 9, 1943).

[19] Kienle, R. H. and Peiker, A. L., Canadian Pat. 411,395 (March 30, 1943).

[20] Atwell, E. C., U. S. Pat. 2,313,727 (March 16, 1943).

[21] Atwell, E. C., U. S. Pat. 2,313,726 (March 16, 1943).

RESEARCH ACTIVITIES

Re-elected president of Arlington Mills, Franklin W. Hobbs is serving his 32nd year as head of that organization. Mr. Hobbs is chairman of the board of directors of the Textile Foundation, a position he has held for fourteen consecutive years; he receives his appointment to the board direct from the President of the United States, and is now serving his fourth four-year term, the last three appointments having been made by President Roosevelt.

North Carolina State Textile School has announced the appointment of Elliot B. Grover as head of its Yarn Manufacturing Department. Mr. Grover, formerly superintendent of the Yarn Manufacturing Division of the Manville Jenckes Corp. of Manville, R. I., is a graduate of M.I.T. in mechanical engineering, and holds several patents ranging from the design of a non-tear balloon fabric to a micrometer thickness gage for fabrics.

William F. Leggett, formerly Associate Editor of Textile Colorist, has accepted an appointment as Associate Technical Editor of Rayon Textile Monthly. Mr. Leggett commences his duties March 1st.

To further the scientific advancement of color knowledge, and, in particular, knowledge relating to the standardization, nomenclature, and specification of color; and to promote the practical application of these results to the color problems arising in science, art and industry is the purpose of the Munsell Color Foundation. The Foundation succeeds the Munsell Color Company, Inc., and is a non-profit organization. Management is under the direction of a board of trustees whose members are well known in color science and industry and include Deane B. Judd, National Bureau of Standards; Dorothy Nickerson, Inter-Society Color Council; and I. H. Godlove, General Aniline and Film Corporation.

The spring meeting of the Industrial Fiber Society is to be held at Clemson College, Clemson, South Carolina, April 14–15. Inquiries should be addressed to John T. Wigington, Secretary, Box 151, Clemson, South Carolina.

"**The limit** of neither poundage capacity nor versatility of rayon has yet been reached," said H. Wickliffe Rose in a recent statement. Mr. Rose pointed out that rayon has not yet reached the ultimate in quality level for normal clothing and household uses and that possibly the most far-reaching in its effects on the rayon business after the war, will be the more general use of rayons possessing greater strength and ruggedness.

Good Housekeeping Institute has appointed Dr. W. E. Coughlin as textile technologist in charge of the Institute's textile laboratory. Dr. Coughlin has been in the technical division of Celanese Corporation of America since

1930. He has been active in research on fabric damage in all types of wearing apparel and household goods, and in industrial research on fulling problems with wool and throwing problems in silk. As director of education for the Celanese Corporation, he appeared before home economists and chemists in various colleges throughout the country.

Infra-red spectroscopy and its value in particular to the organic chemist in rapidly identifying complex compounds, was discussed by R. Bolling Barnes, director of physics division, American Cyanamid Co., Stamford, Conn., at the sixth winter meeting of the Industrial Research Institute. A session on the retaining of research personnel during the war was conducted under the leadership of Emil Ott, director of research, Hercules Powder Co., Wilmington, Del.

Converting liquid uria-formaldehyde and phenol-formaldehyde resins into weight- and space-saving powders is said to give them a storage life double that of the liquid form.

Special research conferences on chemistry and its allied fields will be held as usual this summer at Gibson Island under the auspices of the American Association for the Advancement of Science. The textile section will be held July 10 to 14, inclusive, under the chairmanship of Milton Harris, director of research, Textile Foundation and director of fundamental research, Textile Research Institute, Inc. The program outlined is as follows: "The Chemical and Physical Effect of Plasties and Resins as Applied to Textile Fibers and Fabrics," Donald H. Powers; "Adhesion of Cotton to Natural and Synthetic Rubber," Kyle Ward, Jr. and Carl M. Conrad; "The Effect of Temperature and Humidity on Tire Cord," John H. Dillon; "The Chemistry and Structure of Starch," Sidney M. Cantor; "Regenerated Protein Fibers," Harold P. Lundgren; "Conversion of Globular Proteins into Oriented Fibrous Forms," F. R. Senti; "The Mechanical Behavior of Protein Fibers," Henry B. Bull; "Influence of Environment on Heat Loss from the Body," Eugene V. Dubois; "Factors Relating to the Thermal Insulation Values of Fabrics," Herbert F. Schiefer; and "Water-Vapor Permeability of Fabrics," Lyman Fourt.

Inter-Society Color Council reports that at an informal meeting held for the purpose of discussing illumination as related to textile-color matching problems, certain of the interested individuals thought that differences between results of measured color data and visual matching data might be due in large part to the fact that measured data in use generally assume the illuminant to be I.C.I. Illuminant C, while in actual practice (they thought) the illuminant was considerably higher than C in color temperature. Some believed it might average as high as 25,000° K. This meeting brought out clearly the fact that we lack accurate information regarding color temperatures of the natural lighting under which textile-color matching is practiced, and that we also lack information regarding the color temperature of natural light that is preferred for textile-color matching. Cooperative work on this subject is now being conducted.

Increased Speed is Obtainable Through Reduction of

Vibration in Textile Testing Devices[1]

By R. W. VOSE

A contribution of the Research Division, Chicopee Mfg. Corp.

As part of a critical review of all testing and measuring equipment in the Cotton Laboratory of the Chicopee Manufacturing Corp., two testing devices, the Saco-Lowell Sliver Tester and the Belger Roving Tester, were rebuilt to run at increased speed, and the behavior of a Tensile Tester was investigated. Increasing the speed of the machines required the reduction of inertia, the substitution of springs for dead weights, and other alterations to reduce vibration. The investigation of the Tensile Tester shows that this machine has inherent characteristics which render it unsatisfactory for use on new materials of high elasticity or others with unusual properties.

The speeds of both the sliver tester and the roving tester have been increased by a factor of approximately seven.

The Cotton Laboratory of the Research Division of the Chicopee Mfg. Corp., at Chicopee Falls, Mass., is equipped with three conventional pieces of apparatus in the form of a Scott Pendulum Type Tensile Tester, a Saco-Lowell Sliver Tester, and a Belger Roving Tester. As part of a general program to re-equip all the laboratories of the Division for true research work rather than for routine mill testing, each of these devices was studied critically to determine its suitability for the work involved, its adaptability to other uses than that for which it was designed, and its general fitness as a physical instrument. The outstanding defect in all the machines was found to be considerable inertia and a tendency toward vibration which severely limited the operating speed.

Improving the Sliver Tester

The Saco-Lowell Sliver Tester consists essentially of a grooved roller and a mating tongued roller, the two being forced together and their separation measuring the bulk of any rope-like material passing between them. In the actual device the force between the two rollers is provided by means of a lever and dead weight system, and an extension of this system through additional levers operates a recording pen on a moving chart. The inertia of this weight and lever system, coupled with the spring of the cotton compressed between the rollers, furnished a vibrating system whose motion went out of bounds whenever a sudden change in the size of the material being measured passed between the rolls, or when an attempt was made to increase the speed of operation.

Our first steps in improving the Sliver Tester were to eliminate the in-

[1] Report submitted by the Committee on Vibration, Textile Division, American Society of Mechanical Engineers.

ertia of the moving system as far as possible and to substitute spring loading for the weight loading. In actuality we merely hung the existing weight on springs, and while these weights tended to vibrate in themselves at times we have never found this action to be harmful. The lever system was reconstructed using light metals and very light sections at all points, and even the tracing pen was lightened far beyond its original design. Following this change the speed of the machine was increased, by providing new gears, to a value approximately seven times the original speed. Under these conditions the operation was satisfactory except for a slight steady vibration from the gears which crept through the recording mechanism and resulted in a slight wave on the chart. This was finally eliminated by the insertion of a small rubber bushing in one of the links of the recording mechanism, and we were then able to operate at the high speed with accuracy and fidelity at least equal to that of the original machine. At this high speed we are able to run off an entire can of sliver, of conventional size, in about a two hour period.

In addition to the foregoing changes in the dynamics of the system, we also provided additional speed changes in the chart drive so that we could condense the record from an entire can of sliver into a chart not over a yard long. The original chart speed gave a ratio of chart to sliver of 1:1 and alternatively of 12:1; our changes provided for additional ratios of 144:1 and 1728:1, so that we could in the extreme condense the record of 1728 yards of sliver onto one yard of chart.

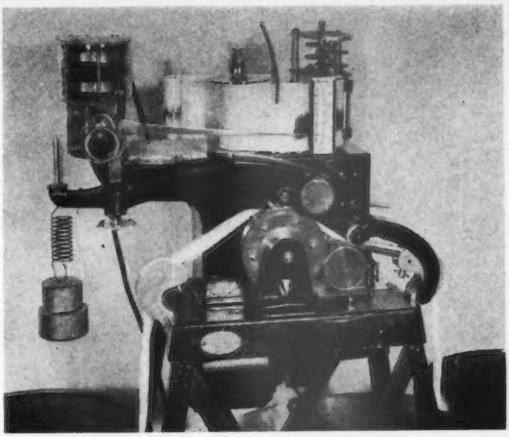


Fig. 1. Saco-Lowell Sliver Tester as modified by Chicopee Mfg. Corp.

The Belger Roving Tester

The program in regard to the Belger Roving Tester was somewhat similar to that for the Sliver Tester. Instead of being a thickness measuring device, however, the Roving Tester is a drafting device with a very light draft, and adapted to measure the force required to produce the drafting. Thus the basic measuring element in the Roving Tester is a force-measuring mechanism, and as originally constructed this was a gravity pendulum with changeable weights to give different scales. In our reconstruction of the apparatus we sawed off the pendulum proper and substituted a spring for the force measurement. All other unnecessary weights, such as pointers, etc., were likewise removed from the moving system and the remaining parts were balanced up so that the only active force was that of the spring against which the roving was stretched. This permitted the force-measuring device to follow rapid changes in applied

force with a faithful record being produced by the tracing pen.

The original speed of the Roving Tester was quite moderate, and we found that with the improved weighing mechanism we could increase the speed by about five or six times, being limited more by the space available for gearing than by any other factor. Our present speed is such that we can test an entire 1.4 pound bobbin of 1.65 hank roving in a period of about 20 minutes, as contrasted with the original operation in which a similar time was required to test only very small samples from the beginning, middle, and end of the bobbin.

The original chart on the roving tester consisted of specially printed individual slips which were used, one for each bobbin. We have slowed down the chart speed greatly, so as to condense the record, and have substituted rolls of adding machine paper for the original printed chart. This permits us to run any associated set of tests on a single strip of chart and retain them in a roll form rather than be troubled with the filing of individual flat charts for each bobbin.

Investigation of Tensile Tester

The pendulum tensile tester used in the laboratory for the testing of yarn and cloth was of the conventional type widely used in the textile industry. Although it appeared to be entirely satisfactory in the routine mill testing, certain special tests on low strength materials and on materials with considerable elasticity indicated that significant errors might exist in the machine when used under unusual conditions. Similar indications have appeared in reports from other sections of the industry, and furthermore there have been proposed a number of methods of calibration of these machines which involved dynamic characteristics. In order better to understand the peculiarities of this type of machine a mathematical analysis was made of the vibratory motion during its operation, and a rough series of tests was run to determine the effect of damping of the test material on this vibratory motion. Much of the analytical work is in agreement with certain analyses and tests which subsequently were published in England, in the June, October, and December, 1942, issues of the *Journal of the Textile Institute,* but the work on the damping and other secondary effects appears not to have been before attempted.

The primary mathematical analysis of the pendulum type tensile tester shows that as load is applied to the specimen the pendulum and recording mechanism moves in an oscillatory manner. Starting from rest, the pendulum speeds up to double its average velocity, then slows down to zero velocity, and then speeds up to twice the average, and repeats this cycle throughout the loading. Thus the indications of the machine are alternately low and high, and because of the reaction of the motion of the weighing mechanism on the specimen the applied loads are alternately high and low, with respect to the nominal uniform rate of loading. Thus there are cyclic errors of considerable magnitude between the actual load and the indication of the machine, and these were not only calculated, but were also shown to exist by motion picture and other studies of the machine.

In addition to the vibratory character of the pendulum motion the inertia of the pendulum comes into play after the fracture of the specimen and causes the machine to overshoot the actual load at fracture. The magnitude of this type of error is dependent

on the speed of motion of the pendulum and varies in magnitude according to the particular part of the vibratory cycle, previously referred to, in which the actual break occurs.

The primary analysis leading to the foregoing results is based upon the consideration of the inertia of the pendulum under the control of linear restoring forces. One of these restoring forces is gravity which operates in the usual fashion on the pendulum, while the other is the elasticity of the specimen itself which operates as a linear spring. These conceptions must be considerably modified in practice, since the specimen does not behave linearly and since it also may have considerable damping. The effect of the damping has been determined quantitatively for common cotton weaving yarn and with this the damping is adequate to absorb a large part of the vibrational energy and thus to leave the final result of the test without serious error. Such may not be the case with newer materials of special constructions which are now being developed for specialized mechanical applications.

The non-linearity of the common textile materials particularly at low loads is likewise a factor which tends to mitigate the vibratory tendency. The actual extent of this effect has not yet been evaluated, but it may be noted that with the modern materials it may be much less pronounced than with older types.

The analysis is applicable to verification loading as well as to test loading of the machines. Dynamic verification has often been advocated, with two primary objects. One of these has been to remove friction, while the other has been to allow for inertia as present in the actual test. Since the vibratory motion is definitely a function of the restoring force of the specimen, it can be shown that the cyclic errors may be entirely altered if the specimen is even slightly changed in elastic properties, and from this it follows that no one verification procedure can possibly allow for the errors to be encountered in practical testing. Actually, the dynamic verification may double the error at a particular load, instead of compensating for the error.

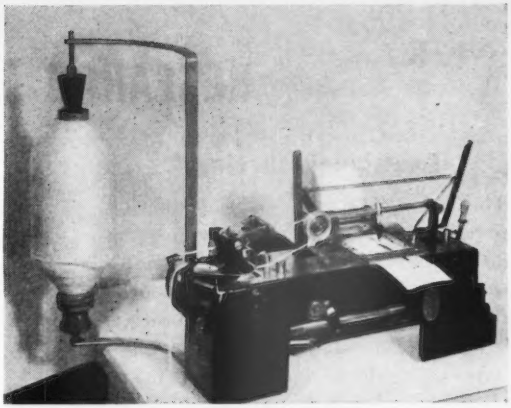


Fig. 2. Belger Roving Tester as modified by Chicopee Mfg. Corp.

A comparison of the possible errors of the machine in our laboratory when operating on our own materials with the possible errors reported for machines of English construction and operated according to English practice showed that the machines in this country probably have considerably smaller errors than those in England. The reason for the difference lies in the heavier pendulum and higher testing speed in vogue in England. However, as we go to more refined tests, and to more resilient and elastic materials, we may expect to find unsatisfactory testing conditions in this country comparable to those currently reported in England.

RESEARCH AIDS

Emulsion Technology*

This book is a new edition of the papers read at the second Symposium on the "Technical Aspects of Emulsions," held by the British Section of the International Society of Leather Trades Chemists. In addition to these papers, which were prepared by authorities in their respective fields, there are included sections by American specialists.

Readers of the book will learn much concerning the application of the science and technical art of emulsions and emulsification to many industries, including wool. Many practical formulas are given; a section includes a listing of patents and a critical review of the patent literature; and a section is devoted to design of emulsifying machines. The section entitled "Emulsions and Emulsification in the Wool Textile Industry" was written by Drs. J. B. Speakman and N. H. Chamberlain. Professor Freundlich of the Sir William Ramsay Laboratories, London, has contributed a chapter dealing with the emulsifying and de-emulsifying action of ultrasonic waves.

* EMULSION TECHNOLOGY. A Symposium. *Chemical Publishing Co., Inc., 26 Court Street, Brooklyn, N. Y. 290 pp. Price $5.00.*

★

Ancient and Medieval Dyes*

The historical record of animal, vegetable and mineral dyes used by ancient and medieval craftsmen is presented in the first of a series of books by William F. Leggett on the historical phase of the textile industry.

Included among the highlights which enliven the book are anecdotes such as how the British came to be called "Redcoats," how blue became the official color for naval use, and what is considered to be the first historical use of camouflage in war, 300 B.C. How the course of history was affected by the attempt to secure control of the then scarce and prized dyes used in textiles for the adornment of royalty is interestingly related.

This is the first time that such information has been gathered in a single book and is the result of several years research on the part of the author who for many years has written on the subject of dyes and textiles. The second book of the series "The Story of Linen" will go to press in June, to be followed by books of similar size and design on wool, cotton, silk, spinning, weaving, and machinery.

* ANCIENT AND MEDIEVAL DYES. William F. Leggett. *Chemical Publishing Co., Inc., 26 Court St., Brooklyn N. Y. 116 pp. Price $2.50.*

★

Temperature Measurement and Control*

Recognition of the importance of temperature, its measurement and control has led to rapid progress in many fields. Many universities have placed more emphasis in their curricula upon training in measurement of temperature, heat transfer, etc.; instruments of greatly improved design and accuracy have become available; and engineering societies have established standing committees especially concerned with

the subject. In the field of textiles, temperature is playing a vital role in the control of processes, and recent studies of heat transfer have led to the design of clothing which will afford greater bodily comfort and protection under the rigorous conditions imposed by global warfare.

This volume is a record of a "Symposium" on the subject held in 1939 under the auspices of the American Institute of Physics. The Symposium received the cooperation of a large number of organizations and 125 papers prepared by leading authorities in the various fields were presented. Among the subjects of particular interest to scientists and engineers in the field of textiles, are papers included in the chapters: Temperature in Biology, Temperature and its Regulation in Man, and General Engineering.

* TEMPERATURE—ITS MEASUREMENT AND CONTROL IN SCIENCE AND INDUSTRY. *Reinhold Publishing Corp., 330 West 42nd St., New York, N. Y. 1302 pp. Price $11.00.*

★

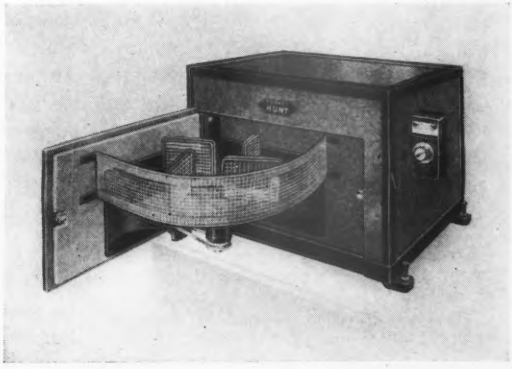
Whirlwind Sample Dryer

Phenomenal speed in the drying and conditioning of sample swatches, etc., is a feature of this dryer, according to tests reported by the manufacturers. This unit, manufactured by the Rodney Hunt Machine Co., operates on an entirely new principle.

The samples are placed on wire screens on a disk or rotor which is attached to the inside of the door of an insulated cabinet (see illustration). The door is closed, the motor turned on, and the samples rotate at high speed inside the cabinet building up an effective air velocity of approximately 6,000 feet per minute. This forces air under pressure directly through the cloth. After the sample is dried, the door is opened and the samples continue to rotate at room temperature and humidity until conditioned. It is said that worsted suiting can be dried and conditioned in less than 1½ minutes. Thirty-four ounce Army Melton requires about 3½ minutes to dry and condition, and lighter fabrics in proportion.

It is reported by the manufacturers that the dryer is a decided improvement over old methods when matching samples.

Inquiries about the dryer should be sent to Rodney Hunt Machine Co., Orange, Mass.



Whirlwind sample dryer employs new principle for drying sample swatches, etc.

Research by Textile Foundation Reveals Nature of

The Scale Substance of Wool

By WALTON B. GEIGER[1]

The scaly outer layer of wool fibers is commonly believed to protect them from injury and to assist in the felting process. Little is known about the composition of this layer because no ready means of separating it from the rest of the fiber has been available. Earlier work in this laboratory has shown that wool that has been reduced with thioglycolic acid and then alkylated with ethyl bromide is attacked by pepsin in such a way that the scale material remains intact while the interior of the fiber is completely dissolved. The composition of the scale material so obtained has now been studied. It has been found that it is essentially protein in nature and, although it contains the same amino acids as the whole wool, the proportions of these in the two materials differ.

I. Introduction

A wool fiber consists of three concentric regions—a thin outer layer called cuticle, usually about 1 to 2 microns thick and made up of overlapping scales, the cortex or main body of the fiber, and a central pith or medulla, which is often lacking [1].[2] The cuticle has been suggested to have a protective function, since it is mechanically tougher and chemically more stable than the rest of the fiber [1, 2, 3, 4]. Also, it has been suggested that the ability of wool fibers to felt is at least partially dependent on the scales (literature reviewed in [5]).

Little is known about the composition of the scales, since ready means for separating them from the rest of the fiber have not been available. From experiments involving partial hydrolysis of wool with hydrochloric acid, Trotman, Trotman, and Sutton [4] concluded that the scales were richer in sulfur than the cortex. Also, a number of investigators [6, 7, 8, 9] have concluded from color tests made under the microscope that the cuticle contains little or no tyrosine.

Recent work in this laboratory [10] has shown that wools which have been chemically modified by reduction with thioglycolic acid followed by alkylation with methyl iodide or ethyl bromide are attacked by pepsin, and that the pepsin digests the inner portions of the fiber leaving the cuticle intact. The present paper reports some analytical results on the composition of scale material prepared in this way.

II. Experimental Procedure

1. Reduction and Alkylation

The reduction and alkylation were carried out by methods similar to those previously described [11, 12]. One hundred and forty grams of wool was

[1] Research Associate at the National Bureau of Standards, representing the Textile Foundation.

[2] Figures in brackets indicate the literature references at the end of this paper.

reduced for 24 hrs at 35° C. with 4000 ml of a 0.2 *N* solution of sodium thioglycolate brought to pH 8.0 with potassium hydroxide. The yarn was then removed from the solution, washed thoroughly with water, and alkylated by treating it for 2 hrs with 2000 ml of a 0.1 *N* phosphate buffer solution at pH 8.0 in which had been suspended 25 g of ethyl bromide. After again washing the wool with water, the processes of reduction and alkylation were repeated. The product was again washed, dried, and finally comminuted in a Wiley mill.

2. Treatment with Pepsin

The chemically modified wool was suspended in 3000 ml of a 0.2 *M* solution of potassium chloride, which was adjusted to pH 1.1 by the addition of hydrochloric acid, and which contained 1.0 g of pepsin.[3] The suspension was kept at 35° C. and slowly stirred for five days. After this length of time, examination under the microscope indicated that the residue consisted practically entirely of scales and that all the cortical material had been dissolved.

The scale material was separated by centrifuging and was washed several times with a 5-percent solution of potassium chloride, and several times with distilled water. The material was then dried by washing it first with alcohol and then with ether, and finally drying in a vacuum desiccator over concentrated sulfuric acid. The dried product formed a light-brown horny mass weighing 3.283 g, and therefore represented about 2.3 percent of the weight of the wool.

[3] From Fairchild Bros. and Foster, New York City.

Fig. 1. Part of scale, released from treated wool by pepsin, showing its mottled appearance and fimbriate margin.
Electronmicrograph × *16,000*

III. Results and Discussion

Preliminary qualitative tests of the scale material indicated that it was composed largely of protein. It gave a positive zanthoproteic [13] and biuret [13] reaction. Moreover the Millon [13] reaction, given by proteins containing tyrosine or tryptophane, the alkali-plumbite [14] reaction, given by those containing sulfur, and the Sakaguchi [13] reaction, given by those containing arginine, were all positive. The Ehrlich [13] reaction for amino sugars was negative. Only a faintly positive test for carbohydrate was obtained when the Molisch [13] test was applied. No carbohydrate could be detected using Fehling's solution or by Beek's [15] method. A test for bound lipid by the method of Anderson [16] showed that the material contained 2.7 percent of lipid. On ignition [17] 4.13 percent of ash was found to be present.

Analysis for nitrogen by the micro-Kjeldahl procedure of Clarke [18]

Fig. 2. Part of cortical cell showing fibrils and microfibrils.
Electronmicrograph × *26,500*

led to 13.53 percent, somewhat less than the amount usually present in proteins, but correction for ash, lipid, and the ethyl groups introduced chemically increased this to 15.17 percent, a value just slightly lower than that given by wool (Table 1). This difference seems largely due to the smaller arginine content of the scale material which contained only about half as much arginine (4.3 percent) as whole wool (8.6 percent). Arginine is the richest in nitrogen of the amino acids. The scale material contained 4.83 percent of sulfur [20], which is considerably more than that contained in untreated wool (3.50 percent). Correction for ash, sulfur, and ethyl groups increases this figure to 5.42 percent and makes this contrast even more apparent.

TABLE I.—Composition of untreated wool and of wool scales

Constituent	Untreated Wool	Wool scales Analytical value	Wool scales Corrected value[a]
Sulfur	3.50	4.83	5.42
Cystine	12.2	18.1[b]	20.3[b]
Nitrogen	16.67	13.53	15.17
Arginine	8.6	4.3	4.8
Tyrosine	6.1	3.0	3.3
Serine	9.5	9.9	11.2
Ethyl groups	0.0	4.0	—
Ash	0.2	4.1	—
Lipid	—	2.7	—

[a] Corrected for the presence of ethyl groups, and bound lipid as described in the text.
[b] Calculated from the sulfur content.

The sulfur in the scale material was probably largely in the form of S-ethyl cysteine, since analysis for ethyl groups [21] showed that 4.0 percent was present, a result which shows that 1.51 millimols of sulfur and 1.38 millimols of ethyl groups were present per gram of the scale material. This S-ethyl cysteine had doubtless been formed from cystine by the reduction and alkylation processes used in preparing the material.

Analysis of the scale material for tyrosine [22] showed that it contained only about half as much (2.97 percent) as wool does (6.10 percent). Analysis by the method of Nicolet and Shinn [23] showed that the scale material contained about the same amount of serine as wool.

IV. Conclusions

Analytical studies on the cuticle and whole wool show that although both contain the same amino acids, the proportions of these in the two materials differ. The presence of larger amounts of sulfur presumably means that the protein of the scales contains more sulfur cross-links between its peptide

chains than do the more digestible proteins of the cortex. Nevertheless, even when the sulfur cross-links have been broken as in the present product, the material is not digested by enzymes. Moreover, the scale material was found to be more stable toward alkali than wool that had been reduced and alkylated in the same way, since the alkali-solubility [24] of the scale material was found to be only 42 percent and that of the treated wool, 85 percent.

Two possible explanations might be advanced at this time to account for the difference in behavior of the cuticle and the cortex of wool. Speakman and also Rudall have suggested that, since the cortex of wool fibers is attacked more rapidly by sodium sulfide than are the scales, cross-links other than those involving sulfur may be present. This hypothesis is attractive and is given support by the results of the present work, although direct proof of the existence and nature of such cross-links is still lacking. An alternative explanation might be sought in the recent demonstration by Hock and McMurdie [25] with the electron microscope that the cuticle and cortex differ widely in physical organization (see Figs. 1 and 2).

V. References

[1] Hock, C. W., Ramsay, R. C., and Harris, M., *J. Research NBS* **27**, 181 (1941) RP1412.

[2] Rudall, K. M., *Proc. Leeds Phil. Soc., Scientific Sec., IV, Part I,* **13** (July 1941).

[3] Speakman, J. B., *J. Soc. Chem. Ind.* **50T**, 1 (1931).

[4] Trotman, S. R., Trotman, E. R., and R. W. Sutton, *J. Soc. Chem. Ind.* **45T**, 20 (1926).

[5] Barker, S. G., "Wool Quality," His Majesty's Stationery Office, London (1931).

[6] Kronacher, C. and Lodemann, G., "Technik der Harr- und Wooluntersuchungen," Urban and Schwarzberg, Berlin (1930).

[7] Bekker, J. G. and King, A. T., *Biochem. J.* **25**, 1077 (1931).

[8] Haller, R., *Textilber.* **18**, 5 (1937).

[9] Unna and Golodety, quoted by H. Mark, "Beiträge zur Kenntnis der Wolle," Einzeldarstellung aus dem Kaiser-Wilhelm-Institut der Faserstoffchemie 1 (1925).

[10] Geiger, W. B., Patterson, W. I., Mizell, L. R., and Harris, M., *J. Research NBS* **27**, 459 (1941) RP1433.

[11] Patterson, W. I., Geiger, W. B., Mizell, L. R., and Harris, M., *J. Research NBS* **27**, 89 (1941) RP1405.

[12] Geiger, W. B., Kobayashi, F. F., and Harris, M., *Ind. Eng. Chem.* **34**, 1098; *J. Research NBS* **29**, 381 (1942) RP1506.

[13] Hawk, P. B. and Bergeim, O., "*Practical* Physiological Chemistry," Blakiston, Philadelphia (1937).

[14] Zahnd, H. and Clarke, H. T., *J. Biol. Chem.* **102**, 271 (1933).

[15] Beek, J., *J. Research NBS* **27**, 507 (1941) RP1438.

[16] Geiger, W. B. and Anderson, R. J., *J. Biol. Chem.* **129**, 519 (1939).

[17] *Assoc. Official Agr. Chem.,* "Official and Tentative Methods of Analysis" 116 (1925).

[18] Clarke, E. P., *J. Assoc. Official Agr. Chem.* **24**, 641 (1941).

[19] Thomas, L. E., Ingalls, J. K., and Luck, M., *J. Biol. Chem.* **129**, 263 (1939).

[20] Elek, A. and Hill, D. A., *J. Am. Chem. Soc.* **55**, 3479 (1933).

[21] A. Elek, *Ind. Eng. Chem., Anal. Ed.* **11**, 174 (1939).

[22] Lugg, J. H. W., *Biochem. J.* **31**, 1422 (1937).

[23] Nicolet, B .H. and Shinn, L. A., *J. Biol. Chem.* **139**, 687 (1941).

[24] Harris, M. and Smith, A. L., *J. Research NBS* **17**, 577 (1936) RP928.

[25] Hock, C. W. and McMurdie, H. F., *J. Research NBS* **31**, 229 (1943) RP1561.

ABSTRACTS

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ANALYSIS: TESTING LABORATORY METHODS

★

Fiber Measurement

New methods of measuring the properties of cotton fibers. K. L. Hertel. *Rayon Textile Monthly* **24**, 529–31; *Ibid.* 603–4 (Oct.–Nov. 1943).

Instruments and methods used in the Fiber Research Laboratory of the University of Tennessee are discussed, including two types of fibrographs for evaluating fiber length (the seed cotton fibrograph and the random sample and lint cotton fibrograph), the arealometer for measuring the specific surface, a property which varies directly with fineness, and the Pressley instrument for measuring fiber strength. All these instruments are useful new tools, whose results, however, should be interpreted with caution until their significance is properly understood. Overenthusiasm in their use is likely to do much damage to the cause of research.

Impact Testing

Impact testing of textiles. Herbert Leaderman. TEXTILE RESEARCH **13**, 21–9 (June 1943).

The theory of impact tests applied to textiles is briefly discussed. The operation of inclined plane and pendulum or ballistic type of testers is described. Impact tests on textiles should be carried out preferably at a constant velocity of deformation. This can be effected easily with the freely falling weight arrangement. By means of an electrical-resistance "weigh-bar" the tension in the specimen as a function of extension can be obtained. In this way the yield-point, breaking load, ultimate extension, and work to rupture under impact conditions may be determined. Comparison of these data with corresponding data obtained at constant rate of stretch at usual testing speeds will show the effect of high rates of stretch on the mechanical properties of textiles.

Cotton Fiber Strength Study

Machine and operator variations on the Pressley cotton fiber strength tester. Jacob V. Shepherd. *"Bulletin,"* Cotton and Fiber Branch, Food Distribution Administration, U. S. Dept. of Agriculture. Digest in TEXTILE RESEARCH **13**, 17–19 (July 1943).

A newly developed cotton fiber strength testing machine, known as the Pressley Cotton Fiber Strength Tester, has been found to provide results which are highly correlated with those obtained by the well-known Chandler round-bundle method of determining tensile strength of cotton fibers. The tests on the new machine can be made about 6 to 8 times as rapidly as with the Chandler method, and therefore its adoption is rapidly taking place in various cotton fiber testing laboratories. A comparison was made of the results obtained upon a large number of varieties of cotton by different operators using eight different Pressley machines.

Viscosity Determination

A rapid cupriethylenediamine viscosity method for control work. R. M. Levy, P. Muffat, and W. D. Harrison. *Paper Trade J.* **118**, 29–31 (Feb. 10, 1944).

A rapid method for the determination of the disperse viscosity of cellulose is presented. The solvent used in the relatively stable cupriethylenediamine solution. The method employs a specially designed type of wet disintegrator which enables the operator to use moist pulp samples without

previous drying. The procedure is especially well adapted to routine pulp and paper mill control where "mass production" control procedures are required. The entire test, including all operations in duplicate, can be carried out by unskilled workers in approximately 20 minutes with a degree of reproducibility of 1% or better.

Fluorine in Wool

Determination of fluorine in wool treated with fluorides. F. F. Elsworth and J. Barritt. *The Analyst* (*British*) **68**, 298–301 (Oct. 1943).

A method for the determination of fluorine in wool moth-proofed by treatment with fluorides is described. The sample is ashed, and the fluorine distilled from the ash as fluosilic acid and estimated colorimetrically by its decolorizing action on thorium-alizarin lake. Satisfactory recoveries of known amounts of fluorine added to wool have been obtained. The method is designed to determine up to 0.5% of fluorine (on the weight of wool) with an accuracy on the order of 5%.

CHEMICAL AND PHYSICAL RESEARCH

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The Cellulose Molecule

The form and mobility of the cellulose molecule. P. H. Hermans, J. de Booys, and C. J. Maan. *Kolloid Z.* **102**, 169–80, Feb. 1943 (through *Kodak Abstr. Bull.* **29**, 382, Oct. 1943).

The configuration of a straight cellulose chain is deduced analytically on the basis of purely stereochemical considerations, using known atomic distances, valence angles, and the van der Waals radii of the atoms. In order to fit the extended length of a cellulose residue with the fiber period, as determined by x-rays, a spatially bent form is required, and the rings of adjacent glucose groups cannot lie exactly parallel to each other. This model differs only slightly from that previously deduced from x-ray data. The spatial packing of several straight and parallel chains can be made to agree with the density, also obtained from x-ray data, if the chains of the layers following one another in the direction of the c-axis alternate in polarity, and are shifted relative to each other a certain distance in the direction of the fiber axis. Cellulose chains can change relatively easily from the straight configuration to the more or less strongly bent or kinked forms. The relatively low solidification temperature of cellulose and the deformation of regenerated cellulose are consistent with such a transition.

Cellulose Solvents

The nature of the cupriethylenediamine cellulose solvent. R. M. Levy and P. Muffat. *Paper Trade J.* **118**, 32–6 (Feb. 3, 1944).

A comprehensive study of the nature of the cupriethylenediamine cellulose solvent is presented. A study of the factors involved in the various complex reactions of this solvent with cellulose is given, together with a complete summary of previous work on this subject. An attempt was made to bring theory and experimental fact into agreement, and a number of facts are presented that have been apparently overlooked in th past.

Properties of Cellulose

Electrokinetic properties and surface conductivity of cellulose and oxycellulose, with reference to the carboxyl group content. Gertrude Rabinov and E. Hymann. *J. Phys. Chem.* **47**, 655–68 (Dec. 1943).

Experimental conditions and theoretical considerations affecting the streaming-potential method in the case of cellulose are investigated and discussed. In distilled water, the zeta potential decreases and the surface conductivity increases with increasing carboxyl-group content of cellulose. Substitution of carboxyl hydrogen by calcium and sodium lowers the surface conductivity, but affects the zeta potential little. A theoretical interpretation of these results is given. The maximum in the zeta-C curve for alkali chlorides is not due to a dispersion of the surface conductivity which shows a marked increase with concentration.

The zeta-C curves, in these cases, are found to be similar to those obtained by Briggs and by Bull and Gortner with different celluloses. The difficulty of reconciling the increase of surface conductivity with a simultaneous decrease of zeta-potential is pointed out, and two tentative explanations suggested. The investigation is concerned with purified cotton, cotton wool, oxycellulose, mercerized cellulose, and regenerated cellulose.

Colloids

Rheological properties of colloidal solutions, pigment suspensions, and oil mixtures. R. N. Weltmann and H. Green. *J. Applied Phys.* **14**, 569–76 (Nov. 1943) (through *Bull. Inst. of Paper Chem.* **14**, 109, Dec. 1943).

The authors studied the validity of Arrhenius' law (that viscosities of colloidal solutions and suspensions increase logarithmically with the concentration of solid matter in the liquid) in that region of concentration where plasticity occurs. They found that, in the paint and printing ink industries, an exponential law, similar to the one conceived by Arrhenius for Newtonian viscosities of colloidal suspensions, is essentially correct for plastic viscosities of plastic materials and also for yield values in a region from medium to high concentration. If two suspensions of different but fairly high concentrations are available, the application of this law makes it possible to prepare any other concentration with predictable plastic viscosity and yield value. Any desired mixture can be obtained on the basis of approximate calculations from the exponential equations given in this paper.

Creep and Recovery

Elasticity, creep and recovery of commercial viscose and acetate rayon yarns. Jack Press and H. Mark. Paper presented at the Pittsburgh, Pa. Meeting (1943) of American Chemical Society.

Flow and recovery curves of commercial viscose and acetate rayon yarns were investigated over a period from 10^{-1} to 10^{6} seconds; the stresses varied between 0.1 and 0.7 gram per denier. It was first attempted to represent the experimental curves point by point numerically with the aid of an equation containing: (1) An instantaneous elastic extension, the modulus of which was taken from the velocity of propagation of sound or ultrasonic waves (moduli are around 8×10^{10} dynes per sq. cm.); (2) one or two delayed elastic contributions, having smaller moduli (around 10^{10}) and times of retardation between one tenth and fifty seconds; (3) a term representing viscous flow, having viscosities above 10^{8} poises; (4) in most cases, it was necessary to add a term proportional to the logarithm of time. It was then attempted to correlate the above contributions to different elementary molecular processes, which contribute to the elongation of the yarn: (1) the instantaneous elasticity seems to be due to the stretching of van der Waals bonds or hydrogen bridges; (2) the delayed elasticities can be ascribed to the uncoiling and straightening of curled and kinked chains in the disordered areas of the samples; (3) viscous flow seems to indicate slippage of straightened out chains along each other; (4) the logarithmic creep can be correlated with phase transitions during the stretching process. The above correlation must be considered to be a tentative working hypothesis, which needs further experimental check and theoretical refinement.

Cotton Fibers Under Tension

The lateral expansion of cotton fibers under tension. W. James Lyons. TEXTILE RESEARCH **13**, 21–5 (Sept. 1943).

Measurements made in the Southern Regional Research Laboratory on approximately 1,200 cotton fibers showed, in general, a lateral expansion under tension. This effect is discussed. The effect is of interest because it may be reasonably presumed that this characteristic has an influence on the behavior of yarns and cords under certain conditions.

Cotton Wax

Observations on the causes of turbidity in dispersons of cotton and modified cotton in cuprammonium. G. F. Davidson. *J. Text. Inst.* **34**, T97–102 (Nov. 1943).

Four samples of hydrocellulose prepared from raw cotton by different treatments

were dispersed in cuprammonium, and the insoluble residues were separated by centrifuging, washed free of solvent and examined. The hydrocelluloses were prepared by treatment of the following with conc. HCl: (A) Raw Egyptian Cotton; (B) A after extraction with chloroform; (C) A boiled under pressure with dilute NaOH; (D) C after extraction with chloroform. Only D exhibited a clear solution when dispersed in cuprammonium. The insoluble portion of A and B exhibited behavior characteristics of pectic substances. The residue from A gave an X-ray diffraction pattern different from hydrocellulose but similar to that of the chloroform extract. This residue was partially soluble in chloroform. Residues from A and C gave turbid solutions in 2.5 N NaOH at —5° C, while those from B and D were clear. Thus cotton wax contributes to the turbidity of cuprammonium solutions of hydrocelluloses from raw cotton and is solely responsible for the turbidity of hydrocellulose solutions in NaOH at —5° C.

Cystine Linkage

The reactivity of the cystine linkage in keratin fibers. Part V. The action of benzoquinone. By J. L. Stoves. *Trans. Far. Soc.* **39**, 301, 305 (Nov. 1943).

The effects of concentration, temperature, and pH upon the reaction of p-benzoquinone with keratin fibers have been examined. Changes in the load/extension curves of fibers treated with aq. solutions at the boil, indicate that the reaction gives rise to the formation of new linkages within the fibers, thereby increasing the resistance of keratin to decomposition of hydrolysis and by oxidation. Using boiling solutions of 2% benzoquinone, maximum formation of new linkages occurs at pH 7. In more alkaline solutions extremely rapid polymerization of the quinone greatly reduces the number of new linkages formed, the effect being particularly marked above pH 8. Suggestions are made as to the nature of the linkages as well as to those formed by the action of benzoquinone upon fibers whose cystine linkages have been reduced by pretreatment with $Na_2S_2O_5$.

Cystine Linkage

The reactivity of the cystine linkage in keratin fibers. Part IV. The action of formaldehyde. By J. L. Stoves. *Trans. Far. Soc.* **39**, 294, 300 (Nov. 1943).

Determination of the load/extension curves of keratin fibers before and after boiling for 1 hour in 2% HCHO pH 2–10 shows that at all pH values new linkages are formed, the greatest number, as estimated by the difference in behavior of HCHO treated and buffer-treated fibers, occurring in the neighborhood of pH 7. At all pH values the amino groups of a proportion of the salt linkages take part in the reaction. In the case of fibers treated with boiling solutions of 2% HCHO below pH 3 or above pH 9, linkages are formed which are stable to 1 hour in boiling 5% $Na_2S_2O_5$. Fibers treated with boiling solutions of 2% HCHO pH 3–8 contain relatively few of these linkages. Linkages formed by treatment for 1 hour with boiling 2% HCHO pH 6 confer upon the fiber a partial immunity to attack by oxidizing agents. No increased resistance, however, is shown to hydrolysis by boiling water. The probable nature of the new linkages is discussed.

Phosphorescence

The phosphorescence of textile fibers and other substances. H. E. Millson. *Textile Colorist* **65**, 495–7, 503–6 (Nov. 1943).

Exposure to ultraviolet light causes textile fibers to phosphoresce as well as to fluoresce. Phosphorescence, which is the continued emission of visible light after cessation of exciting radiation, was found to be most powerfully induced by 2537 A ultraviolet rays in which the Skidmore cold quartz lamp is especially rich. It is suggested that the measurement of differences in phosphorescence may be a means of detecting in textile fibers chemical damage difficult to detect by other methods. For example, in the case of nylon, as short an exposure as one hour in the fadeometer caused a definite loss in phosphorescence; partial saponification of acetate rayon was vividly shown by the contrasting colors of the phosphorescence of saponified and

unsaponified portions after dyeing with Calcomine Brilliant Flavine S. The experimental procedure for measuring phosphorescence (for which eyes must be dark adapted) is described, and extensive data is listed on the fluorescence and phosphorescence of dyed and undyed yarns, fabrics, paper and miscellaneous compounds.

Polyamide Fibers

The fine structure of polyamide fibers. K. Hess and H. Kiessig. *Naturwissenschaften* **31**, 171, No. 14/15 (Apr. 2, 1943) (through *Kodak Abstr. Bull.* **29**, 382, Oct. 1943).

The x-ray structures of hexamethylene-diamine-adipic acid and e-aminocaproic acid fibers were investigated. When drawn out or stretched, these materials yield a very strong median interference which appears to be characteristic of synthetic polyamides. On heating the stretched polyamides, the lattice spacing is increased; this spacing does not diminish when the materials are cooled.

Polyamide Fibers

The relation between the structure of polyamide fibers and silk fibers. R. Brill. *Z. physikal. Chem.* **53B**, 61–74 (Jan. 1943).

The observations of Nowotny and Zahn (*Ibid.* **51B** 265, 1942) on the space configuration of polypeptide chains were corrected, using more recent data on molecular and atomic distances. The newly calculated distance of two polypeptide chains in the direction of the hydrogen bridge is 4.77A., which is in good agreement with the value of 4.83A. found for polyamides. A comparison of the x-ray diagrams of polyamides and of silk fibers demonstrates the similarity of structure of these materials and makes possible the evaluation of silk fiber diagrams. The results are in good agreement with many properties of this material found experimentally. Using these evaluations, a structure is proposed in which the zigzag chain lies in or almost in the plane which contains the intermolecular hydrogen bridges. This is in conformity with the views of Elod, Nowotny, and Zahn on the fine structure of wool keratins.

Fibrillar Structure of Rayon

Fibrillar structure of high-tenacity rayon. L. M. Welch and W. E. Roseveare. Paper presented at the Pittsburgh, Pa. Meeting (1943) of American Chemical Society.

Seventy percent nitric acid has been used to aid in breaking down rayon filaments into fibrils, which can be seen with the optical microscope. A series of x-ray diffraction patterns and photomicrographs shows the effect of crystallite orientation on fibril formation in synthetic cellulose fibers. Rayons having high crystallite orientation show distinct fibrils, whereas unoriented rayon does not have a fibrillar structure. Natural and synthetic cellulose fibers, showing the same over-all crystallite orientation with respect to the fiber axis, may have a considerably different crystallite orientation in the fibrils since the natural cellulose fibers have the well-known spiral arrangement about the fiber axis.

Starch

The configuration of starch in the starch-iodine complex. IV. An x-ray diffraction investigation of butanol-precipitated amylose. R. E. Rundle and Frank C. Edwards. *J. Am. Chem. Soc.* **65**, 2200–3 (Nov. 1943); cf. *B. I. P. C.* **14**, 66 (through *Bull. Inst. of Paper Chem.* **14**, 125, Dec. 1943).

Diffraction patterns from wet and dried butanol-precipitated amylose confirm a helical starch chain with a helix diameter of about 13.7 A., a length per turn of about 8 A., and six glucose residues per turn. The helices approximate a close-packed arrangement in both the wet and dried precipitates, with alternate helices directed in opposite directions. The space group for both structures is probably D_2^4—P2$_1$2$_1$2. The space between the starch-iodine complex and the dried butanol precipitate confirm the proposal that, in the starch-iodine complex, the iodines occupy the interior of the helices, and it is suggested that, in butanol-precipitated amylose, the butanol occupies the interior of the helix. The cell previously reported for the starch-iodine complex must be a pseudo-cell with only pseudo-hexagonal symmetry.

Starch

X-ray fiber pattern from amylose with a glycerol plasticizer. R. E. Rundle and Lester W. Daasch. *J. Am. Chem. Soc.* **65**, 2261–2 (Nov. 1943) (through *Bull. Inst. of Paper Chem.* **14**, 124, Dec. 1943).

Brief reference is made to the fact that the x-ray diagrams obtained from amylose fibers containing plasticizers are quite different from those containing no plasticizers. An example of amylose with glycerol plasticizer is given; the fiber spacing is 7.5 A., which is very different from the 10.6 A. spacing found for the "B" modification of starch. It indicates the flexibility of the starch chain which is not to be found in the cellulose chain.

A New Industrial Starch

Amioca—a new industrial starch. C. G. Caldwell. *Paper Trade Journal* **117**, 27–29 (Oct. 14, 1943).

Amioca, the starch produced from a new variety of corn, popularly known as "waxy maize" is characterized by its lack of amylose. It competes with tapioca and other related starches but differs from them in that it retains the fluidity and non-jelling character of the original starch.

Starch

Waxy cornstarch as a replacement for tapioca. H. H. Schopmeyer, G. E. Felton and C. L. Ford. *Ind. Eng.* **35**, 1168–72 (Nov. 1943) (through *Bull. Inst. of Paper Chem.* **14**, 125, Dec. 1943).

Waxy corn which had been developed to a high-yielding hybrid was grown on a commercial scale and wet-processed with only minor changes in operating procedure. The waxy starch forms a clear, soft, non-gelling paste and has been found to replace high-grade tapioca satisfactorily in dextrins, adhesives, paper coatings and sizes, textile sizes and finishes, print gums, and food products. It is chemically different from other starches in that it is substantially pure amylopectin or branched-chain portion of starch. It is to be expected that such a starch will find special uses where it is more suitable than the present commercial starches. 16 references.

Starching Technique

Proper starching technique. Ernest R. Kaswell. TEXTILE RESEARCH **13**, 26–31 (Sept. 1943).

A study was made of the effect of starching variables on fabric stiffness. It was found that a linear relationship between the amount of starch used and the weight of material such as frequently used does not hold. By proper use of graphs the correct amount of starch for any given weight may be determined.

DYEING: BLEACHING: FINISHING

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Continuous Bleaching

Continuous open-width peroxide bleaching. Winn W. Chase. *Textile World* **94**, 76–8 (Jan. 1944).

The installation at Riverside & Dan River Cotton Mills of the new system developed by Du Pont chemists and engineers is described. The system speeds up the production of herringbone twill and other Army fabrics. Additional advantages include uniformity of treatment, saving in chemical costs, and reduction in manpower requirements. Production averages around 2500 to 3000 lb. per hour, and chemical costs are estimated to be between $1.50 and $2.00 per 1000 lb. of cloth, or about half that of older methods. Less than 750 lb. of steam per 1000 lb. of cloth is required against 2500 to 3000 lb. in the kier method. There is practically no degradation of the cotton as measured by cuprammonium tests.

Dyeing of Cellulose

The effect of salts upon the dyeing of cellulose. S. M. Neale. *J. Soc. Dyers and Colourists* **59**, 148–9 (July 1943).

The theory advanced by Hanson, Neale and Stringfellow (*Trans. Faraday Soc.* **31**, 1718 (1935)) to account for the salt effect in the dyeing of cellulose with direct dyes has been recently criticized as inadequate by Usher and Wahbi (*J. Soc. Dyers and*

Colourists **58**, 221–28 (Nov. 1942)). The present paper is a rebuttal by Neale of Usher and Wahbi's argument and a criticism of some of the experimental work that led to the latter's conclusions. Neale defends his original view that the salt effect is accounted for over a wide concentration range by a Donnan equilibrium, and states that the opposite conclusion reached by Usher and Wahbi depends wholly upon the highly arbitrary value for w (the quantity of water operating as solvent in the "cellulose phase") obtained by their "blotting-off" technique. Neale further argues that a portion of Usher and Wahbi's work is based on the incorrect assumption of uniform ionic distribution in the cellulose phase of the dyeing, and claims finally that the work of the latter authors has provided qualitative proof of the existence of a Donnan effect in the system but has failed to provide basis for a quantitative examination of the dyeing equilibrium.

Printing of Piecegoods

The printing of piecegoods and related processes. *I. Cotton* **107**, 79–82 (Dec. 1943). *II. Ibid.* **108**, 75–78 (Jan. 1944).

A series of articles will give a comprehensive treatment of the subject. The author for many years operated the largest printing plant in America. Article I covers the preliminary processes: singeing, de-sizing, boiling-off, temperature regulation, bleaching processes, the "continuous" bleach, and the preparation of rayon goods. Article II discusses the white room, drying, dyeing, and printing colors.

Raw Stock Dyeing

The effect of raw stock dyeing on the fiber and manufacturing properties of cotton. Southeastern Section AATCC (paper presented at 1943 Intersectional Contest). *Am. Dyestuff Reptr.* **32**, 527–31, 538 (Nov. 22, 1943).

This paper presents the results of a study of the effects of various dyestuffs and dyeing procedures on the subsequent manufacturing qualities of stock dyed cotton. Sulfur navy, sulfur black, vat pastel blue and naphthol red dyeings were made in lots of one thousand pounds or more using customary mill formulas, and exhausting tests were carried out on the dyed stock thus produced, and on yarn manufactured from it. Tests on the stock showed that dyeing resulted in no significant decrease in fiber length nor in upper quartile length, and no decrease in strength occurred except in the sulfur black where a six percent loss was noted. The fineness of the fibers was not changed by dyeing, and no chemical damage was found with the exception of mild degradation (3.3 and 3.6 rhes) in the case of both sulfur colors. Mechanical damage was not produced. The significant facts established in examination of the manufacturing properties of the dyed stock were: increased waste on the card, increase in neps in the card web, decrease in yarn strength and accompanying increase in end breakage in the case of the sulfur black, and decrease in quality of the yarn appearance in all the dyed samples.

Soap in Dyeing and Finishing

Soap in dyeing and printing processes. Georgia Leffingwell. *Textile Colorist* **66**, 2–4 (Jan. 1944).

A discussion of textile applications for soap. Formulas are given. A list of literature references is appended.

Union Dyeing

The dyeing of union fabrics. E. B. Abbott. *Textile Colorist* **65**, 441–45 (Oct. 1943). (From the *Indian Textile Journal.*)

The principle and problems involved in union dyeing are briefly discussed and particulars are given for dyeing wool-cotton (or wool-viscose) by both the one bath and the two bath methods. For the former method which is most generally preferred, direct dyestuffs which dye the cotton much heavier than the wool and neutral-dyeing acid dyestuffs provide a highly flexible combination and meet most fastness requirements. Dyeing is carried out just below the boil, then necessary shading is accomplished by careful addition of either type of dye well below this temperature. Union dyestuffs, marketed as such, are convenient when solid shades or mixtures comprising approximately equal parts of

animal and cellulose fiber are desired. For clear two-color effects and bright shades the two bath method is employed, and here cotton dyes should be chosen which at low temperatures give good reservation on the wool and high tinctorial value in the cotton.

Wool Dyeing

Minimum chrome necessary for afterchrome dyeing. Philadelphia Section, AATCC (first prize winner, 1943 Intersectional Contest). *Am. Dyestuff Reptr.* 32, 502–10, 512 (Nov. 22, 1943).

The amount of chrome specified in the usual formulas for dyeing wool by the afterchrome method has been without scientific basis. Dyeings have been made with a number of chrome dyes using various percentages of sodium bichromate and the resulting dyeings graded as to quality from the standpoint of shade, tinctorial value and fastness to light and washing. Insufficient bichromate produces inferior fastness while overchroming also causes poor fastness and thin dull dyeings. Experiment showed, however, that considerable reduction could be made in the amount of chrome normally used, and in fact optimum results were obtained when using, in general, one-half the amount used in practice today. Several million pounds of wool have now been dyed with excellent results using this reduced amount of chrome. A spectrophotometric method for determining the optimum amount of chrome for individual dyes is outlined, and mill formulas found satisfactory for dyeing are presented.

Stripping Dyed Textiles

Stripping dyed textiles. "Technicus." *Textile Colorist* **66**, 5–10 (Jan. 1944).

Methods for application of the various stripping agents together with advantages and disadvantages of each are described. Particular attention is given to the use of reducing agents such as the zinc sulfoxylate formaldehyde-compounds. In stripping woolen goods, and in particular, shoddy, a mild alkaline scour is recommended as a preliminary treatment. Prolonged treatment with detergents is harmful. Use of penetrants and dispersing agents results in saving of chemicals and in preserving the quality of the goods. Some general stripping methods for various types of dyestuffs are described. Attention is called to the catalytic action of residues of metallic compounds such as titanium salts used in stripping or that may have been used in the dulling of rayon, as it is well known that those may accelerate oxidizing processes to the degree that tendering may occur. In the stripping of chrome mordant dyes it should be noted that any chromium oxide residues will have a similar effect in the case of oxidizing treatments. However, the helpful effect of catalysts must also be considered, an example being the use of anthraquinone in conjunction with sulfoxylate-formaldehyde discharge styles. A small amount, usually about 3% of the weight of the reducing agent, is added to the print paste and in the case of many of the azoic types of dye a much better discharge is produced. Some quaternary ammonium compounds such as Leucatrope O (dimethyl - phenyl - benzyl - ammonium chloride) and the W. brand which is the disulfonate of this compound exhibit a purely catalytic effect. Both are used in conjunction with sulfoxylate-formaldehyde compounds and caustic soda for the stripping and discharging of indigo and vat dyestuffs.

Light Fastness

New proposed standards for light fastness. Northern New England Section AATCC (winner of second prize, 1943 Intersectional Contest). *Am. Dyestuff Reptr.* 32, 511–12 (Nov. 22, 1943).

The degree of light fastness of a given dyeing is now customarily evaluated by comparison with a standard dyeing of a specified dye, each step of fastness usually requiring a different dye. It is now proposed by the authors to use as fading standards only two dyes and two dyeings—one of the dyes (Erio Chrome Azurole B, 0.4%) being fugitive to light and the other (Indigosol or Algosol Blue AGG, 3.0%) being fast. These two colors are dyed separately on slub wool, then blended in all desired proportions and made into yarn and cloth for fading standard samples, exact and readily controlled steps of fastness thus

being obtained. Some of the advantages of this method are: good reproducibility, simplicity, small change in hue from one standard to the next, not much change in hue on fading, and fastness to washing.

Color

Spectropotometry and the colorist. E. I. Stearns. *Am. Dyestuff Rept.* **33**, 1–6, 16–20 (Jan. 3, 1944).

In 11 pages of text, including 18 figures, Mr. Stearns, chief physicist of Calco Chemical Division, American Cyanamid Company, presents from the textile colorist's point of view an explanation of spectrophotometric curves and how they may be analyzed and interpolated to give the colorist additional information on his problems. Applications of these methods of interpretation to twelve mill production and research problems are suggested. The paper contains solid information for the textile man who uses a spectrophotometer.

Wash-fastness of Direct Dyes

Fibrofix. C. C. Wilcock and C. P. Tattersfield. *J. Soc. Dyers and Colourists* **59**, 119–24 (June 1943).

"Fibrofix" is the name given to a new textile auxiliary product which has been found to increase very materially the fastness to washing of direct cotton dyes. The many cation-active compounds so far brought out have increased fastness in other respects (i.e., water, cross-dyeing), but have had practically no effect on the resistance of dyes to soaping. It is pointed out that for the same dye and percentage shade, the washing fastness will increase with an increase in the diameter of the filaments (or fibers) involved, due to the fact that more dye is required on a fine than on a coarse filament for the same depth of shade. For this reason dyes are sometimes found to be faster on filament rayon than on cotton. Fibrofix combines with the sulfonic or carboxyl groups in dye molecules to form salts of lower solubility, and thus is used as an aftertreatment. In general such aftertreatment caused direct dyes to be as fast to a 30 min. treatment with .5% soap and .2% soda ash at 140° F. as a corresponding untreated dyeing at 104° F. Direct dyes representing a range of color were found which, after treatment with Fibrofix, withstood soaping for 20 minutes at 194° F. The chemical composition of Fibrofix is not stated. A table showing change in shade and light fastness caused by the Fibrofix treatment for seventy-six direct dyes is presented.

Water-Repellent Finishes

Effects of water temperature in evaluating the efficiency of water-repellent finishes. H. G. Walz and K. R. Fox. TEXTILE RESEARCH **13**, 11–15 (Aug. 1943).

It has been previously shown that water temperature in the conventional spray chest may under critical conditions be responsible for the acceptance or rejection of a lot of material. Variations as large as 100 percent in ratings may result from tap water variations expected in the ordinary laboratory. The present investigation was undertaken to establish the relationship existing in the well known hydrostatic pressure tests. Among many fabrics investigated were samples of both the resin type and wax-aluminum salt type. The permanent or resin type showed very little decrease in hydrostatic pressure with temperature. The wax-aluminum salt type showed a pronounced change in pressure rating. It is shown to be advisable adequately to emphasize specifications for testing which incorporate methods for controlling the water temperature.

FIBERS: YARNS: FABRICS: MECHANICAL PROCESSES

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Processing Cow's Hair

Processing raw cow's hair and cow's hair felt. S. Wouble. *Textile Colorist* **65**, 507–9 (Nov. 1943).

Cow's hair which is made into felt for carpet pads, insulation purposes and the like, contains much spent lime acquired in the tannery and before scouring, felting and dyeing it must be thoroughly delimed. This is accomplished by steeping for about twelve hours in a warm dilute HCl solution. Scouring is carried out in a fashion similar to the scouring of raw wool

and is then ready for dyeing with acid or direct dyes, the choice of dyestuffs depending upon the severity of the felting operation to follow and upon the amount of vegetable matter to be covered, as well as the fastness required. Alternately, the material may be felted and then dyed in sheet form in a circulating machine. For low grades of felt, and when jute is mixed with the hair, dyeing with basic dyes proves quite satisfactory. Occasionally felts require weighing and this is effected by the iron tannate method, being followed by treatment with glycerine and thorough conditioning.

Palmetto Fiber

Scrub palmetto. Anon. *Modern Industry* **7**, 38–9 (Jan. 15, 1944).

Development of new products from the hitherto worthless scrub palmetto in Florida is briefly described. The plant has a log-like root which yields a pith and a fiber. The fiber is expected to be used for brush bristles, upholstery stuffing, and twine. The pith is now being used entirely for ordinance items but it is expected that some will be released shortly for non-ordinance use. Three basic products are ready for production: insulating board, insulating wall panel, and prefabricated wall panel for low cost housing.

Fibers of New Mexico

The fiber of native plants of New Mexico. C. W. Botkin. *Chemurgic Digest* **2**, 189–92 (Nov. 15, 1943) (through *Bull. Inst. of Paper Chem.* **14**, 111, Dec. 1943).

Reference is made to a study of fibers from native plants in New Mexico for use as cordage fiber or in certain papers; four species of plants were found in sufficient abundance to be of possible value. Three of these are yuccas, *Yucca glauca, Yucca elata,* and *Yucca baccata,* and the fourth a nolina, a coarse, grass-like plant. A fourth yucca species, *Yucca macrocarpa,* gives a very high fiber yield, which, however, is more than offset by the scattered stand of the plant. Strength tests indicate that the fiber from the baccata and macrocarpa is as strong or stronger than manila or hemp, which is among the strongest commercial fibers. The elata and glauca fibers are stronger than *Palma ixtle,* but the nolina is somewhat weaker than the jute or African sisal. All the other desert-plant fibers mentioned are as strong as those hitherto in use for cordage and bag making. Other uses for these fibers may be expected. One paper company in the eastern United States has been obtaining carload shipments of *Yucca glauca* which is used in making a special kind of paper for the navy. By-products, such as saponin from the yucca roots, deserve more consideration.

Machine-gun Belts

Fabric saves metal in machine-gun belts. James A. Hendley. *Textile World* **94**, 69–71 (Jan. 1944).

The article describes the development of .30 and .50 caliber belts, the type of belts employed, yarn specifications, fabric construction, drawing in drafts, chain drafts, and finishing processes utilized.

Quality Control

A fresh approach to quality control. O. P. Beckwith. *Textile World* **94**, 79–81. 130–40 (Jan. 1944).

Technique employed in the control-chart method of controlling quality during production is illustrated by a practical example of its application in the operation of yarn spinning. In this example which follows through the operations necessary for statistical control, five steps are followed: (1) rational sub-grouping of data, (2) development of the sampling scheme, (3) specification of the criterion for control, (4) specification of the action to be taken when an observed value falls outside its control limits, and (5) specification for the state of statistical control.

Physical Properties of Fabrics

Physical properties of 26 work garment fabrics. Margaret B. Hays. *Rayon Text. Mo.* **25**, 72–4 (Jan. 1944).

There was no correlation between the number of cycles required to produce a hole with the Taber machine and either the percentage loss in breaking strength or the actual breaking strength after abrading on the Wyzenbeek. When the data from the two tests are considered together, the

gabardines, herringbone twill, and whipcords are the ones most resistant to abrasion. These materials, as a group, also had the highest breaking strength in both the warp and the filling direction of test. Laboratory ratings based on the Taber and Wyzenbeek abrasion machines may serve to evaluate work clothing fabrics until serviceability tests determine the required minimum for such properties as breaking strength and count. The Wyzenbeek test showed that certain fabrics were more resistant to abrasion in the warp than in the filling, while others withstood fillingwise abrasion best. These facts may be utilized in making garments so that the fabric would take the prevailing abrasion in the direction it is most resistant to abrasion.

MISCELLANEOUS

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Textile Mill Electrification

50 years of textile mill electrification. Winn W. Chase. *Textile World* **94**, 56–63 (Jan. 1944).

The history of electrification at Columbia (S. C.) Mills commencing with the first installation in 1894 is given. Recent progress in the industry is described and major developments in the textile-mill application of electrical and electronic equipment are considered. Post-war possibilities are discussed.

Radiant Heat

Infra-red drying of textiles. Stefan L. Grapnel. TEXTILE RESEARCH **13**, 18–28 (Aug. 1943).

Tests were conducted using a standard 24 inch infra-red ray gas generator on fabrics to determine: (1) the validity of the theoretical drying equation; (2) influence of cloth weight on drying; (3) effect of distance of the cloth from the burner; (4) effect of color; and (5) influence of the type of material. It is shown that the drying time is directly proportional to the natural logarithm of the ratio of the initial and final moisture content and also is proportional to the fabric thickness. No consistent influence of color was observed. The weight of fabric was shown to be less important than the weave. The author concludes that gas generators of the type used depend for their efficiency mostly on converted heat. Suggestions for future research are given.

Wax Substitutes

Wax substitutes. Charles S. Glickman. *Chem. Ind.* **53**, 496–500 (Oct. 1943).

With the increasing scarcity of natural waxes, more and more users are turning to synthetics entirely or to blends of natural and synthetic materials. The preparation and characteristics of some of the more important synthetics are described here along with suggestions for their use alone and in blends. Also described is a method for the laboratory evaluation of synthetic waxes or mixtures that eliminates the necessity for costly and time-consuming service tests. It is shown that the recrystallization rate of waxes serves as an excellent index of their physical properties. For example, a wax or mixture having a recrystallization rate similar to that of carnauba wax will have similar physical properties to carnauba wax. 16 references.

Synthetic Detergents

Synthetic detergents. Foster D. Snell. *Soap San. Chem.* **19**, 31–3 (Nov. 1943). (Through *Technical Abstracts* 1943, 11 884.)

The more common non-soap detergents, their composition, characteristics and uses are described. By properly balancing a hydro-carbon chain with one or more solubilizing groups, synthetic compounds can be prepared having surface-active and, in some cases, marked detergent properties. By avoiding the $COON_a$ group, compounds more stable than soap in hard water and in acid solution are obtained. Vast numbers of surface active agents can therefore be formulated.

Textile Calculations

Ready reckoners speed textile calculations. Ernest Whitworth. *Textile World* **94**, 64–5 (Jan. 1944).

Use of tables based on constants saves time in making calculations. Methods for developing and using such tables are described. This article, the first of a series, deals with the conversion of yarn counts from one system to another.